

# 4th Jagiellonian Symposium on Advances in Particle Physics and Medicine



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## Invited talk: Testing Quantum Foundations in the Cosmic Silence

*Tuesday, 12 July 2022 14:00 (20 minutes)*

The VIP experiment, operated at the Laboratori Nazionali del Gran Sasso (LNGS) of INFN, aims to perform high sensitivity tests of the Pauli Exclusion Principle (PEP) for electrons. In the context of Local Quantum Field Theories, deviations from PEP are strongly constrained by the Messiah Greenberg Superselection (MGS) rule, which forbids superpositions of states with different symmetry. Such models can then be only tested with open systems. Such a condition is fulfilled in VIP-2 by introducing new electrons in a pre-existing system of electrons, and testing the resulting symmetry state. An overview of the latest VIP-2 Open Systems result will be presented.

PEP violations, transgressing MGS, were recently shown to be induced by space-time non-commutativity, a class of universality for several models of Quantum Gravity. High sensitivity tests of PEP violation in closed systems represent the better candidates to test the non-commutativity emergence in Quantum Gravity, at unexpectedly high energy scales. The results of exploratory studies will be shown.

The extremely low background environment of LNGS is also suitable for investigating the measurement conundrum, one of the main mysteries of Quantum Mechanics Foundations. Dynamical models of wave function collapse explain the quantum-to-classical transition by a progressive reduction of the superposition, proportional to the increase of the mass of the system. The results of our analyses, setting the strongest bounds on the collapse models, will be presented.

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